Space Weather Technical Forecast

Issued on Friday, 18 March 2022 at 12:46 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor geomagnetic storms on Day 3 (20 March). Slight chance of isolated M-Class flares. Slight chance of Active fluence by Day 4 (21 March).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar Activity has been Low with a C1 flare, at 17/1918 UTC. There are now two numbered sunspot regions on the visible disc; AR2965 located in the northwest quadrant remains the largest, although the magnetic complexity has reduced and it has shown some fading of the trailing spot. AR2967 also in the northwest quadrant has also faded a little. AR2971 has faded completely.
An eruption from southwest of ex-2970 occurred between 17/0200-0400, with early coronagraph imagery suggesting a CME. Further imagery is needed to determine if this has an Earth directed component.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, remained at background levels. Wind speeds declined from near 370 km/s to around 280 km/s. Density was at average to below average levels, around 2-7 ppcc. The IMF, Bt, was weak at 5nT or below. The north-south component, Bz, was weak and ranged between +3/-4nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background. The high energy electron flux (greater than 2 MeV) has been at generally moderate levels, peaking at 282 pfu at 17/1640 UTC. The 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, but with a rising trend. Observed fluence at 18/0000 UTC was 5.96e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be at mostly Low or Very Low levels with an ongoing slight chance of an isolated M-class flare, mainly from AR2965. This chance reduces on Day 4 (21 March) as AR2965 rotates off the west limb.

Solar Wind / Geomagnetic Activity: Solar winds are currently at background levels, and expected to stay that way until Day 3 (20 March). The CME from a filament eruption on March 16th may give a glancing blow early on Day 3. Also, a possible coronal hole high speed stream may arrive during Day 3.
Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 0-3) to start. The CME arrival and/or HSS arrival will give an increased likelihood of Active (Kp 4) intervals, and a chance of G1/Minor (Kp 5) geomagnetic storms, mainly on Day 3.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels, although there is a very slightly above background chance of an increase in response to any larger flares that may occur. The high energy (greater than 2 MeV) electron flux is currently at predominantly moderate levels. Further enhancement in the near term is unlikely. A combination of a possible CME and HSS arrival on

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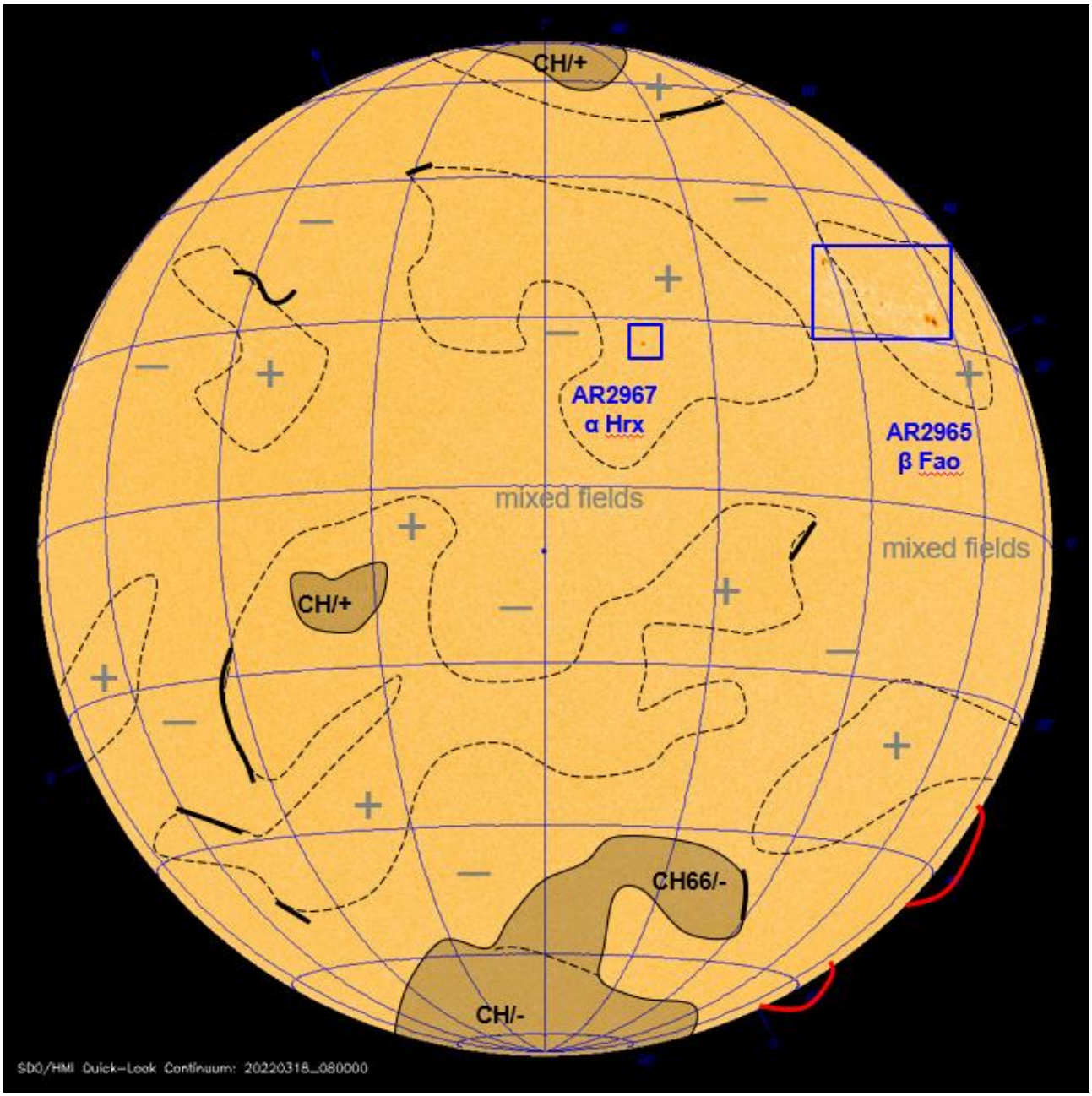
Day 3 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible on Day 4 (21 March), with a rise also possible in the associated fluence level at this time, although this is low confidence due to uncertainty in the CME/HSS forecast.

Figure 1. Solar Analysis Valid 18/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are currently at background levels, and expected to stay that way until Day 3 (20 March).
The CME from a filament eruption which occurred in the northeast around 1230 UTC on March 16th may give a glancing blow early on 20th March. Also, a possible coronal hole high speed stream may arrive during Day 3 from CH66/-, a northern extension of the southern polar crown coronal hole. However, confidence is low regarding this feature as there are differences from the previous rotation. No wind speed increase has yet been detected at STEREO-A, although an increase in magnetic field is occurring which may indicate the beginning of a CIR.
Earlier this morning (18th) a CME was detected in coronagraph imagery, likely from an eruption in the southwest near ex-2970. Further imagery is need to determine if this has an Earth directed component.
Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 0-3) to start. The CME arrival and/or HSS arrival will give an increased likelihood of Active (Kp 4) intervals, and a chance of G1/Minor (Kp 5) geomagnetic storms, mainly on Day 3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	40	10
Strong	G3	No	1	1	2	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1902 UTC	Partial	Filament eruption	NE quadrant	580	20/0600 UTC	Glancing blow.
*	*	*	*	*	*	*

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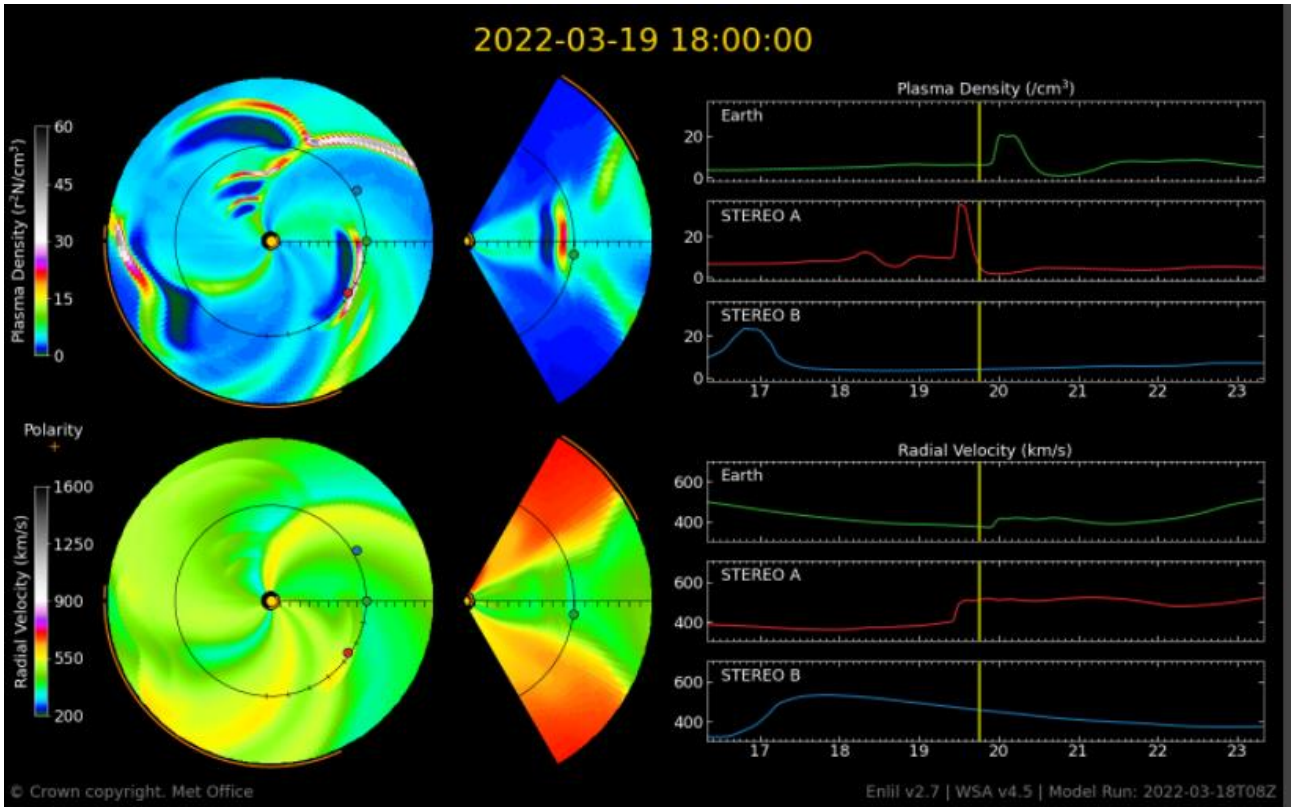
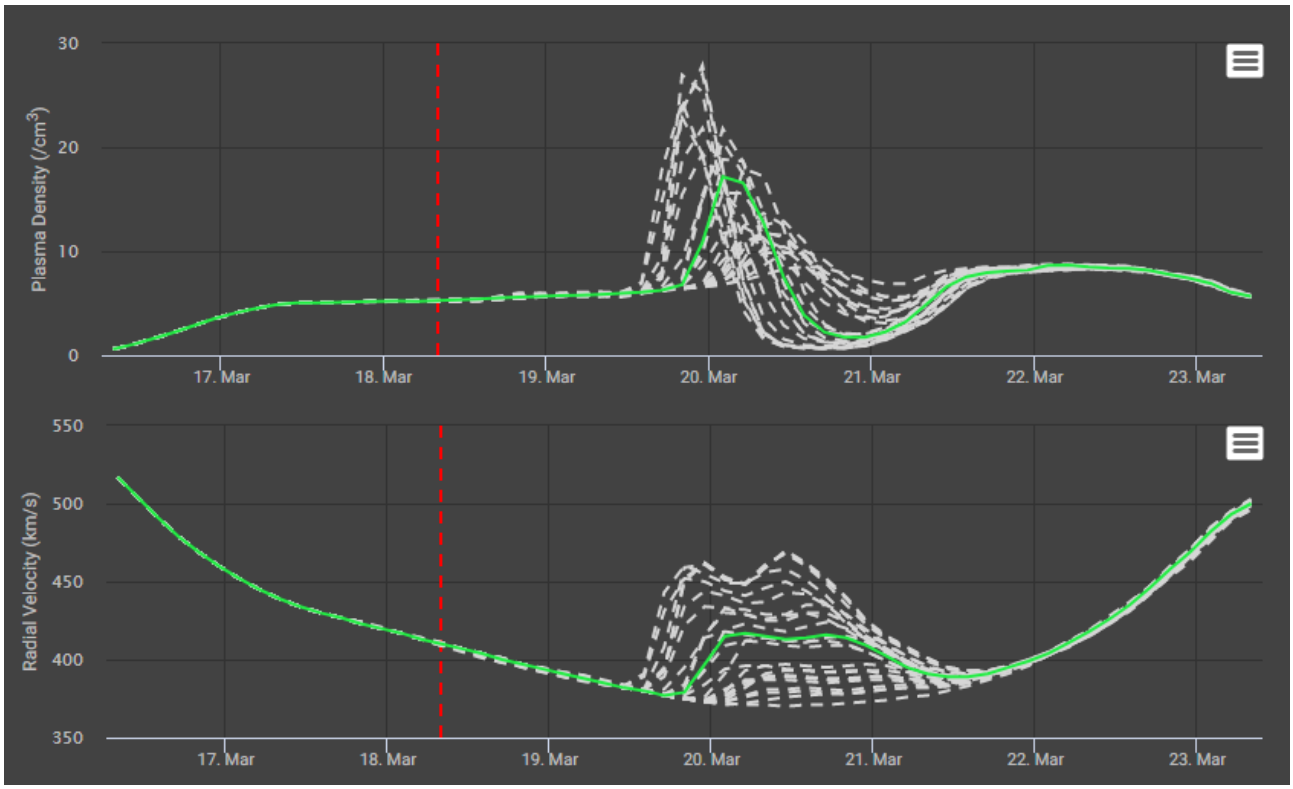
Figure 2: Enlil and ensemble showing likely glancing blow early on 20 March.





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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar Activity has been Low with a C1 flare at 17/1918 UTC. There are now just two numbered sunspot regions on the visible disc; AR2965 (Fao/Beta) in the northwest quadrant remains the largest region. It has however shown decay in its trailing spot, and a simplification of its magnetic structure. AR2967 in the northeast quadrant has also faded a little and is now classified Hrx/Alpha. AR2971 has now faded completely.

STEREO-A imagery shows possible returning regions which may rotate onto the east limb over the next few days.

Solar activity is forecast to continue mostly Very Low or Low with a slight chance of isolated M-class flares, with AR2965 the likely source. However, AR2965 is expected to rotate off the west limb during Day 4 (21 March) so the probability of M-flares will start to reduce at that point.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is currently at background levels, and is expected to remain at this level. Any significant flares from AR2965 may give a potential enhancement, however this region has undergone some magnetic simplification and faded a little in the last 24 hours. Therefore there is now only a very slight chance of reaching the S1 level.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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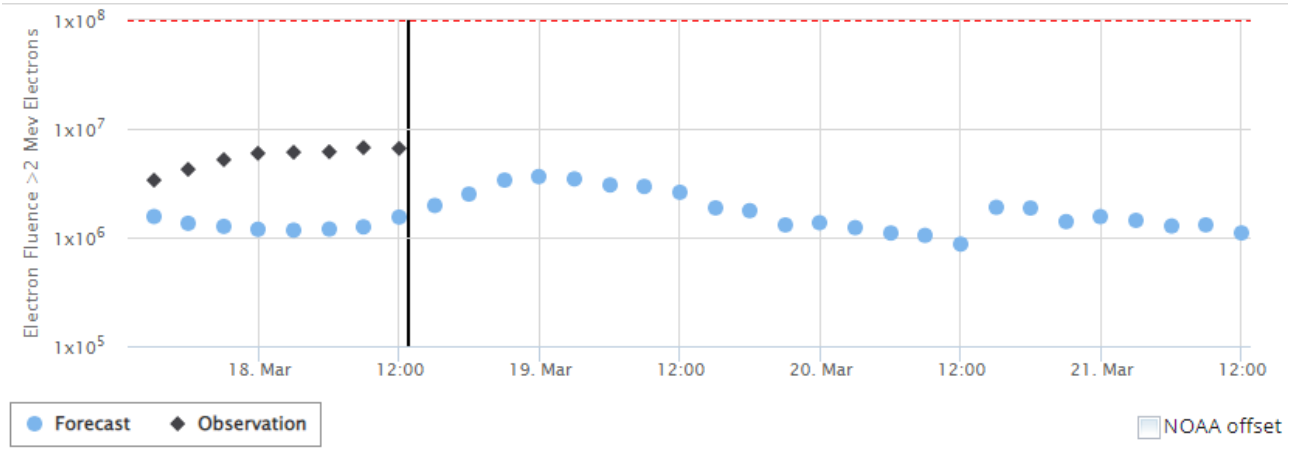
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at predominantly moderate levels. Further enhancement in the near term is unlikely, with no recent significant wind speed enhancements which would have caused charging. A combination of a possible CME and HSS arrival on Day 3 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible on Day 4 (21 March) if the wind speed does increase, once any geomagnetic effects wane.

The associated fluence is expected to stay well below the Active (1e8 integrated pfu) threshold for much of the period. A rise is possible on Day 4, although this is low confidence due to uncertainty in the CME/HSS forecast. REFM is currently underestimating the fluence level - it is probably providing reasonable guidance until Day 3 however.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: REFM is probably providing reasonable guidance until Day 3 (20 March).



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